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A Risk Factor for Stroke from the ENT Clinic: Plaque or Cardiogenic Embolism?

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ABSTRACT

Objective: We previously suggested that aberrations of the carotid arteries, which may occur when the neck is bent forward, should be considered as new risk factors for ischemic stroke. We analyzed the results of carotid artery ultrasound examination in previous case and control groups, focusing in particular on the atherosclerotic risk factor in stroke, to determine the significance of arterial aberration and its relation to ischemic stroke.

Data Sources and Review Methods: We analyzed the original data from our previous 235 case-control study patients among those who underwent complete routine cervical ultrasound and had all cholesterol data available.

Results: Although plaque was present in the CCA in about one-half of the control group, none had experienced a stroke. At the same time, two-thirds of the case (stroke) patients had plaque in the CCA. This indicates that plaque tends to be a risk for stroke, although the difference between the two groups was not statistically significant.

Conclusion: The results of the present analysis indicate that: 1) the degree of atherosclerosis was the same in both the case and control groups, because there were no statistically significant differences between them in cholesterol values; 2) the only difference between the two groups was the aberration of the carotid artery; and 3) aberration of the carotid artery tends to be a risk factor for stroke. The mechanism of cerebral infarction is speculated to be artery-to-artery embolism from the carotid plaque. The aberration of the carotid artery occurs, which triggered by plaque reaching the cerebellum.

Keywords: Head and neck, Carotid artery, Aberration, embolism, plaque.

Introduction:

Carotid abnormalities (CAs) are found in more than half of patients with cardiovascular or cerebral ischemic symptoms who undergo ultrasound examination. Atherosclerosis, hypertension, and aging may all play an important role in the development of CAs, although aging appears more important than atherosclerosis[1]. On the other hand, one study suggested that CAs are not important stroke risk factors[2]. Previous studies mainly focused on the cervical common carotid artery (CCA) and the sections of the external and internal carotid arteries around the CCA bifurcation.

However, aberration of the internal carotid artery (ICA) sometimes occurs inside the mouth in elderly patients with bent posture[3], which is difficult to diagnose in ultrasound examination. Patients with asymptomatic carotid artery stenosis who have a 60% or greater reduction in arterial diameter and whose general health makes them good candidates for elective surgery will have a lower 5-year risk of ipsilateral stroke if carotid endarterectomy performed with less than 3% preoperative morbidity and mortality is added to aggressive management of modifiable risk factors[4]. However, even when magnetic resonance angiography (MRA) is performed within 2 months after actual aberration occurs it is difficult to detect such aberrations because ultrasound or MRA studies are performed in the supine rather than seated position[5].

We previously suggested that aberrations of the carotid arteries in the head (ICA)[6] and neck (common carotid artery, CCA)[7], which may occur when the neck is bent forward, should be considered as new risk factors for ischemic stroke. In addition, a case-control study suggested that aberrant (Ab)-ICA and Ab-CCA were risk factors for stroke and that bent (head-down) posture was a risk factor for the development of aberrant arteries[8].

Although patients with lacunar infarction were excluded from the case group in our previous study, we wanted to determine the actual cause of stroke. Why were the aberrations related to ischemic stroke? Were they due to plaque or cardiogenic embolism? We therefore decided to analyze the results of carotid artery ultrasound examination in the same case and control groups, focusing in particular on the atherosclerotic risk factor in stroke, to determine the significance of arterial aberration and its relation to ischemic stroke.

Methods:

We analyzed the original data from our previous case-control study[8] using the chi-squared test and paired *t*-test. This case-control study was performed at the National Hospital Organization Tokyo Medical Center after the Ethics Committee of each had approved the study protocol. We compared the presence or absence of Ab-ICA or Ab-CCA and of plaque in the cervical carotid artery between 72 stroke patients and 163 individuals in the control group. The total cholesterol, triglyceride, low-density lipoprotein cholesterol, and high-density lipoprotein cholesterol levels were also compared between the two groups. The previous study specifically examined the relationships among bent posture, height loss, aberration of the carotid arteries, and ischemic stroke risk in a case-control manner. Both case and control patients with established risk factors for stroke, such as a history of atrial fibrillation, arrhythmia, heart valve disease, diabetes, blood clotting abnormalities (hematocrit >55%, platelet count >500,000/µl), and who were receiving anticoagulant therapy were excluded from the study[7]. Furthermore, among the 235 patients, only 24 underwent complete routine cervical ultrasound and had all cholesterol data available. As a result, the current analysis involved only a subset of 9 in the control group (without ischemic stroke) and 15 stroke patients in the case group.

Results:

The characteristics of the case and control groups are shown in (Table 1). There were no arterial aberrations in the control group. On the other hand, all ischemic stroke patients were found to have Ab-ICA or Ab-CCA. Cervical ultrasound examination of the carotid artery detected plaque in 5 of 9 in the control group and in 11 of 15 in the case group. As shown in (Figure 1), plaque prevalence was higher in the stroke group than in the control group, although the difference did not reach statistical significance (odds ratio=0.45; 95% CI=0.06–3.1; Fisher's P-value=0.32; Table 2).

(Figure 2) shows the differences between total cholesterol, triglyceride, low-density lipoprotein cholesterol, and high-density lipoprotein cholesterol levels between the case and control groups. The *t*-test results indicated no significant differences in cholesterol ratios between the two groups.

Discussion:

Based on previous results, we estimated that the risk of ischemic stroke was 90.2% based on carotid artery aberration and 91.4% when all risk factors (aberration of the carotid artery, height loss, bent posture) were analyzed. Aberration of carotid arteries caused by cervical bent posture was found to predict ischemic stroke risk in the previous case-control study[8]. The purpose of that study was to evaluate the accuracy of aberration of the carotid artery as an ischemic stroke risk factor, and therefore patients with established risk factors for stroke were excluded. Thus the subset of patients analyzed in this study was much smaller.

Although plaque was present in the CCA in about one-half of the control group, none had experienced a stroke. At the same time, two-thirds of the case (stroke) patients had plaque in the CCA. This indicates

		Stroke	ICA/CCA Aberration	Plaque	TC mg/dl	TG mg/dl	LDL mg/dl	HDL mg/dl
Non-stroke controls	1	–	–	–	248	254	143	54
	2	–	–	–	254	231	154	54
	3	–	–	–	225	129	136	63
	4	–	–	–	173	99	85	68
	5	–	–	+	255	79	169	70
	6	–	–	+	213	156	100	82
	7	–	–	+	217	75	121	81
	8	–	–	+	208	153	120	57
	9	–	–	+	238	120	155	59
Ischemic stroke cases	1	+	+	–	216	134	123	66
	2	+	+	–	196	98	131	45
	3	+	+	–	238	79	162	60
	4	+	+	–	244	136	133	65
	5	+	+	+	262	516	105	53
	6	+	+	+	257	102	189	47
	7	+	+	+	244	113	180	41
	8	+	+	+	177	115	72	82
	9	+	+	+	249	174	159	55
	10	+	+	+	224	307	81	81
	11	+	+	+	186	124	117	44
	12	+	+	+	205	215	116	46
	13	+	+	+	127	107	75	36
	14	+	+	+	218	111	151	44
	15	+	+	+	258	225	169	44

ICA/CCA: internal carotid artery/common carotid artery; TC: total cholesterol; TG: triglyceride; LDL: low-density lipoprotein; HDL: high-density lipoprotein

Table 1: Stroke occurrence, arterial aberration, plaque presence, and cholesterol values in the two groups in the current subset analysis.

	Stroke (N=15)	Non-stroke (N=9)	Odds ratio (95%CI)	P value
Plaque	11 (73.3%)	5 (55.6%)	0.4545 (0.07-3.07)	0.32
ICA/CCA abberration	15 (100%)	0	INF	7.6E-7

CI: Confidence interval; INF: infinity

Table 2: Stroke patients and non-stroke controls with and without plaque and arterial aberration.

that plaque tends to be a risk for stroke, although the difference between the two groups was not statistically significant.

We previously treated patients in whom plaque caused ischemic stroke when their carotid artery became bent. Those patients reported an unusual strange sensation (USS) when the aberration occurred. The USS around the pharynx results from a separation of the pharyngeal wall, which contains the mucosa, submucosa, and superior pharyngeal constrictor muscle, due to Ab-ICA. When that separation occurs, patients feel a USS in the throat. The experience in treating those patients suggested that the occurrence of the separation indicates an increased risk of stroke in the near future and that an ischemic embolism could be triggered[5].

Conclusion:

The results of the present analysis indicate that: 1) the degree of atherosclerosis was the same in both the case and control groups, because there were no statistically significant differences between them in cholesterol values; 2) the only difference between the two groups was the aberration of the

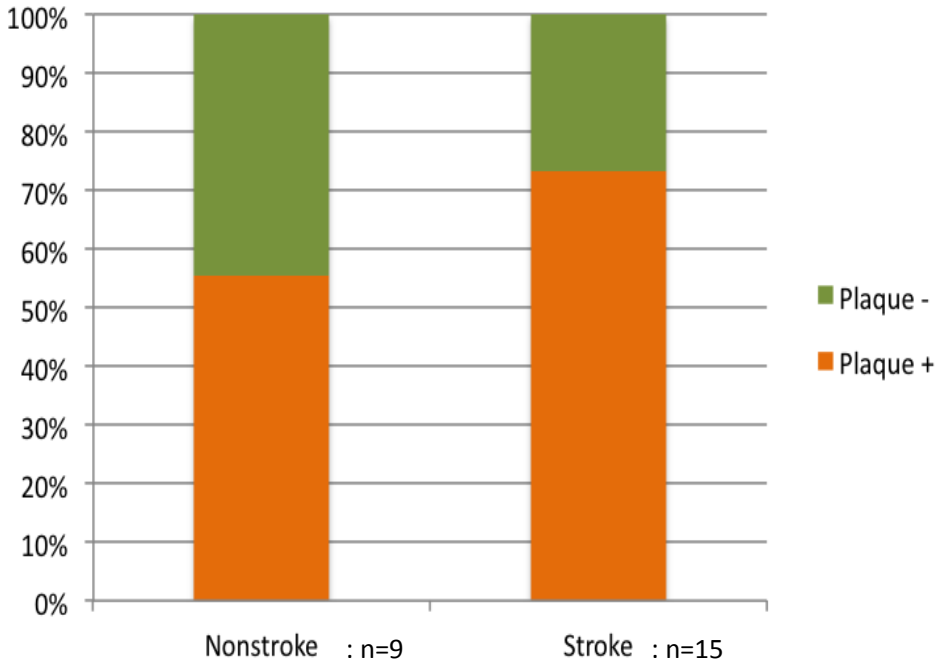

Figure 1: Plaque prevalence in both stroke and non-stroke groups.

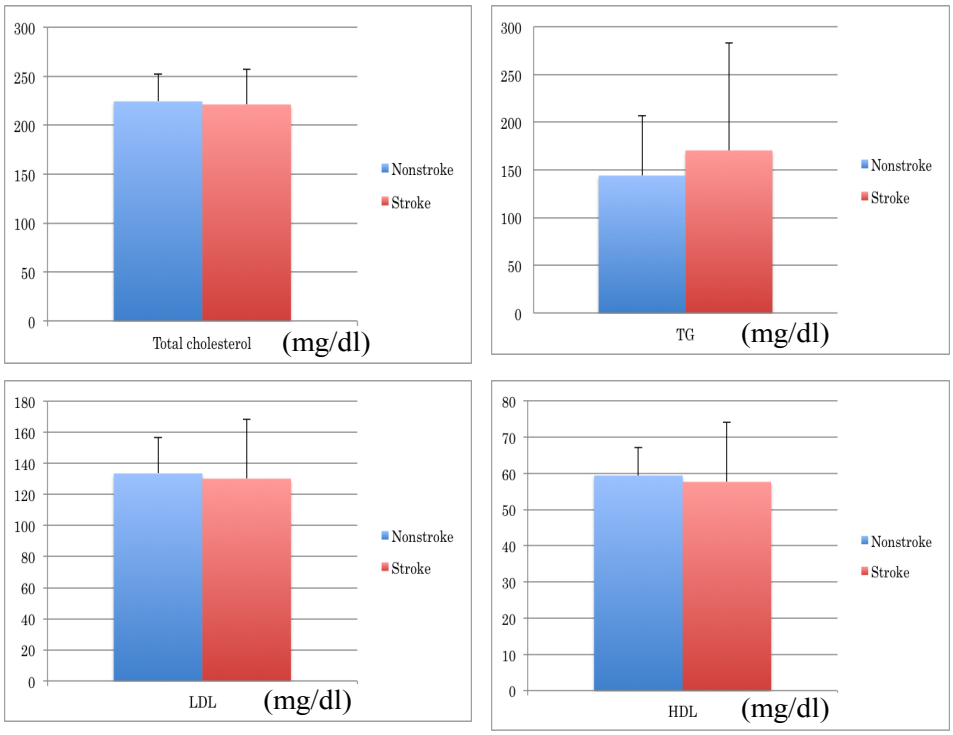

Figure 2: Differences of each cholesterol levels between the case and control groups.

carotid artery; and 3) aberration of the carotid artery tends to be a risk factor for stroke. The mechanism of cerebral infarction is speculated to be artery-to-artery embolism from the carotid plaque. In other words, plaque in the carotid arteries causes an ischemic stroke when aberration of the carotid artery occurs, triggered by plaque reaching the cerebellum.

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